Scanning the Past

Charles Stewart Ballantine

Sixty-five years ago this month, the PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS (IRE) included a paper by Stuart Ballantine on the topic of vacuum-tube detectors subjected to large signals. During his career, Ballantine made numerous contributions to the design of vacuum-tube circuits, measuring instruments, and acoustic devices. He was the author and co- author of sixteen PROCEEDINGS papers published between 1919 and 1934 and received the Morris Liebmann Memorial Award from the IRE in 1931. He also served on several IRE committees and was President of the IRE in 1935.

In his July 1929 paper, Ballantine noted that much work had been reported on the theoretical and experimental characteristics of vacuum tubes with small signals. He continued that the behavior of vacuum-tube detectors was more complex when large signals were applied, but that he had been working on the problem for several years and was ready to disclose his results. He explained how a designer could construct detection diagrams for specific tubes which greatly simplified analysis. He included a section on mathematical theory and described the experimental technique that he had used to verify his theory. He stated that he had used his method to design very linear detectors for commercial radio receivers being used by licenses of the Radio Frequency Laboratories.

Ballantine was born in 1897 in Germantown, PA, and had become an amateur radio enthusiast by 1908. He served as a radio operator on ships during summer vacations from 1913 to 1915. He attended Drexel Institute and was employed as a radio expert at the Philadelphia Naval Yard during 1917-1920, where he was in charge of developing a radio compass for navigation. He published his first IRE paper in 1919 on the theory of thermionic amplifiers. During 1920-1921 he studied physics at Harvard University and then spent a year at the Radio Frequency Laboratories in Boonton, NJ, where he worked on radio broadcast receivers. In 1922, Ballantine published a book entitled *Radio Telephony for Amateurs* and was the recipient of the John Tyndall scholarship at Harvard during the 1923-1924 academic year. He conducted independent investigations of radio propagation and related topics from 1924 to 1927 and then returned to become Director of the Research Division of the Radio Frequency Laboratories.

Ballantine was President of the Boonton Research Laboratories from 1929 to 1934 and worked on the development of measuring instruments, including a logarithmic voltmeter and an automatic recorder for measuring frequency response. He also collaborated with Harold A. Snow on the development of variable-mu tetrodes for the reduction of distortion, which they reported in an IRE paper published in December 1930.

In 1934, Ballantine founded the Ballantine Laboratories, which he headed for the rest of his life. There he developed improved techniques for measuring the performance of microphones and loudspeakers. He invented a throat microphone that proved valuable to aircraft pilots and continued to work on high-quality radio transmitting and receiving equipment. He was awarded the Elliott Cresson Medal of the Franklin Institute in 1934 in recognition of his contributions to the theory of radio antennas. He received more than thirty U.S. patents for his inventions. He was a member of the IRE Board of Editors for several years and also served on the IRE Standardization Committee. Ballantine died in 1944.

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